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GLOBEC - Northeast Pacific Climate Change Mechanisms: An Observational and Modeling Analysis

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We propose to conduct a four-year retrospective project to investigate the mechanisms of climate changes in the northeast Pacific (NEP) that are relevant to variations in marine populations, especially fishery populations. This work will be closely linked to and build on our on-going GLOBEC NEP project, "Patterns, Sources, and Mechanisms of Decadal-Scale Variability in the Northeast Pacific: A Retrospective and Modeling Analysis" in which we are synthesizing and analyzing historical surface and subsurface data sets. Our previous results will be expanded upon by focusing on three main components of climate change in the NEP. In the vertical component, we will focus on sub-basin scale variations in vertical fluxes between the atmosphere and the upper ocean, and identify the degree to which regionally confined mechanical and thermal mechanisms contribute to climate change on seasonal to decadal scales. In the horizontal component, we will focus on the role of advection and propagation within the ocean and atmosphere on seasonal to decadal scales, including oceanic and atmospheric teleconnections. In the dynamical similarity component, we will compare processes described in the first two components to identify their dynamical similarities across time and space scales.

A major new feature of the proposed project is the use of two global, high resolution, eddy-permitting ocean models to simulate fields and processes not adequately represented in observations. We will compare observed and modeled ocean fields to arrive at a more accurate representation of how the NEP responds to climate change. The seasonal cycles of key observed and modeled upper ocean fields will be related to atmospheric forcing fields, and compared with the patterns and mechanisms of similar changes in the interannual and decadal scales, with emphasis on major interannual (e.g., El Ni&#65533;o and La Ni&#65533;a) events, and a possible decadal change that occurred around 1990. Basin scale changes will also be compared to regional changes to see if similar patterns and mechanisms prevail at these different spatial scales. From these analyses, biologically relevant climate indices will be developed from the observed and modeled fields. This project will deliver to the GLOBEC and marine research communities model output and observed data products through web based distribution systems that includes, including interactive access via the PFEL Live Access Server web site. These distribution systems will provide a critical access for GLOBEC investigators to a wide range of environmental data sets and indices that define climate change in the NEP and its ecosystem effects.

Statement of Work for Year One

Many studies of the connections between climate change and fisheries have been based on correlations of physical and fishery quantities (e.g., of sea level pressure or sea surface temperature with indices of production or catch). Such correlations can indicate possible links but do not clearly identify the mechanisms by which the impacts of climate variations are transferred through the ecosystem. In our recent and on-going observational and modeling work on North Pacific climate, we have developed a number of results that are useful in identifying these mechanisms. These results include data extraction and analysis procedures, oceanic and atmospheric models and model output fields, climate indices, and spatial and temporal patterns of intraseasonal to interannual climate variations that contribute to and/or are dynamically similar to decadal climate variations.

We will continue this work in year one, focusing on four key aspects of decadal climate change in the North

Pacific:

1. dynamical relationships between upper ocean heat content and surface wind stress;
2. relationships between basin circulations and coastal circulations;
3. origins of, and indices for, wind stress variations; and
4. decadal changes that developed around 1990.

We will address these topics using both observed and modeled fields, and by applying the results of our prior work on seasonal cycles, intraseasonal to interannual variations, and the decadal changes that occurred around 1976.

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